Kim Cooper Mid-Term Lesson Plan

**Lesson: Designing Solar Ovens**

Grade: 3

Time: 3 class periods (55 mins each)

Unit: Energy

**Description**

This lesson introduces students to one source of green engineering through a project that reinforces the science concepts of energy and energy transfer. Students will brainstorm, design, create, test and improve a solar oven.

Prior to this project, students should learn about many different sources of energy, both nonrenewable and renewable. They should understand some of the pros and cons of different energy sources.

Heat Energy

Scientists define energy as the ability to make change happen. Sometimes these changes are easily to see, such as wind energy causing a windmill to turn. More often, these changes occur on a scale humans can not see. We must rely on evidence of these changes such as light, heat, sound or motion to understand that energy is present. Heat energy is energy from the movement of molecules within a substance. The faster the molecules move, the greater the temperature. Heat energy always moves from a warmer substance to a cooler substance. Students will learn that the Sun is the source of energy for their solar ovens and that heat energy transfer takes place in this experiment.

**New York Scope and Sequence Standards:**

PS 4.1a Observe, identify and describe a variety of forms of energy.

PS 4.2a,b Identify the evidence for energy transformations and how humans use these energy transformations.

PS 4.1 b,c,d Observe and describe how heat is conducted and can be transferred from one place to another.

PS 4.1d Interactions of matter and energy

**Danielson Standards:**

1e Planning and Preparation- Designing Coherent Instruction

2b The Classroom Environment- Establishing a culture for Learning

3b Instruction- Using Questioning and Discussion

3c Instruction- Engaging students in Learning

3d Instruction- Using Assessment in Instruction

Essential Question

***How can we use our knowledge of thermal properties, environmental impact of materials and our creativity to design a solar oven with minimal environmental impact?***

**Objectives**

Students will:

* Design a solar oven
* Identify the materials to make a solar oven
* Conduct a controlled experiment testing how different materials perform as thermal insulators
* Plan, create, test, and improve their solar ovens

**Materials**

Tin foil

Black paper

Felt sheets

newspaper

Plastic grocery bags

Shoe box, small pizza box

Rigid clear plastic such a transparency sheets

Tape

Glue

Scissors

S’mores ingredients: marshmallows, chocolate, graham crackers

Stopwatch

thermometers

\**Before beginning Part 1 of this lesson, work with students to gather all of the materials they might like to use to insulate their solar oven designs. These materials might be brought in from home, collected from outside, or gathered from around the school or classroom. Plan to have students work in groups of 3. You will need to prep each group’s show box by cutting a large flap in the top of the lid using a sharp knife (approximately 6” x 8”)*

Part 1: Plan and Design- Students work in small groups to plan and design their solar oven, including a materials list.

Part 2: Create and Test- Students create their solar ovens. Then, students test their solar ovens by placing them in direct sunlight and measuring their internal temperature over time.

Part 3: Improve- Students reflect on their design. Then they can choose to improve their solar oven and test again.

Part 1: Introduction, Plan and Design

1. Tell students that today they are going to design their own solar ovens. Post the guiding question for students: ***How can we use our knowledge of thermal properties, environmental impact of materials and our creativity to design a solar oven with minimal environmental impact?***
2. Show students the following video about solar ovens; “Cooking Cookies with Solar Power” from PBSLearning Media <http://ny.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsolar/cooking-cookies-with-solar-power/>
3. Discussion Qs: What is the function of each of the following parts of the solar cookers: foil, black paper, plastic baggie? Describe how sunlight is converted into heat by the solar cookers. Why is it important to have a “control” marshmallow?
4. Discuss what the word **insulate** means. *To add material to something in order to stop heat from going into or out of it.*
5. ***You will need to decide which materials to use to insulate your solar oven design.*** Discuss the materials they can choose from. Allow students time to look at all of the different materials that are available on a table. Ask: ***Which of these materials do you predict will work well as an insulator? Why do you think so?***
6. Next, each group should meet to plan their solar oven design. Before building it, they should draw a sketch, and label the materials they will use, and label which parts will reflect sunlight, which will absorb sunlight and which parts will trap heat.

Part 2- Create and Test

1. Groups should gather the materials they will need for their solar ovens.
2. You may choose to show the class a model of a sample oven, or you can provide a set of instructions for students to follow to make a solar oven. Support students minimally as they create their designs.
3. After students have finished constructing their solar ovens, they will evaluate how well their insulation works to keep heat energy inside.
4. Describe the oven testing procedure with students. They will go outside on a sunny day to test. They will place a thermometer inside the oven and take a temp reading every 5 mins for 30 minutes. They will record their data in a table. They will compare their solar oven’s temp to the control (oven with no insulation). Have one students be the time keeper and call out every 5 mins for students to read the temp and record.
5. After, return to the classroom and reflect with the following questions:

* ***What materials did you use to insulate your solar oven? Why did you choose those materials?***
* ***What parts of your oven design worked well?***
* ***Which parts did not work well? How do you know?***
* ***How might you improve your design?***

Part 3: Improve

1. Tell the class that they will have an opportunity to implement some of their improvement ideas and test their designs again. ***What are some things you might change?***
2. Give groups time to improve their oven designs.
3. Then, test again in the same manner as before.
4. Reflection- Post the Essential Question from the beginning and reflect:

* ***How did your group decide which materials to use?***
* ***What happened when you tested your improved design?***
* ***Did your improvement ideas work? How do you know?***
* ***If you could improve your solar oven even more, what might you change about it?***

**Assessment**

Students will be assessed with the following rubric:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Students will be able to…** | **1**  **Novice** | **2**  **Apprentice** | **3**  **Proficient** | **4**  **Distinguished** |
| **Works in a group to plan, design, create, test and improve** | Student does not successfully implement any of the steps of the design process | Students implements as least some of the steps of the design process | Student independently, correctly and completely goes through the design process. | Student is proficient and goes significantly beyond in the design process. |
| **Use prior knowledge of the thermal properties of materials to inform a solar oven design** | Student does not successfully use prior knowledge to inform the design of a solar oven | Student uses prior knowledge to inform oven design. Not all information is correctly used, or student requires significant support. | Student correctly and completely uses prior knowledge to inform their design. | Student participates at proficient level and goes significantly beyond (creates questions for further investigation) |
| **Test and evaluate a solar oven design using established criteria** | Student does not successfully evaluate their solar oven design using established criteria | Student evaluates his/her solar oven design. Evaluation is partially accurate. Student may require significant support. | Student completely and accurately evaluates their solar oven using the established criteria. | Student participates at proficient level and goes significantly beyond (by discussing additional criteria and how they might evaluate them) |
| **Improve their solar oven design** | Student does not successfully improve a solar oven design | Student identifies ways to improve a design with attempt to explain. Response is partially accurate. May require significant support. | Students correctly identifies ways to improve a solar oven design and completely and accurately explains how they are improvements over a poor design. | Student participates at the proficient level and goes significantly beyond (by testing incremental improvements in a controlled manner in order to evaluate their effectiveness) |